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PLANNING THE ELECTRIC WATER SYSTEM AND PLUMBING FOR YOUR FARMSTEAD

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and the

Rural Electrification Administration

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PLANNING THE ELECTRIC WATER SYSTEM AND PLUMBING FOR YOUR FARMSTEAD

Extension of electricity throughout rural America makes it possible for farm families and other rural residents to have running water and a complete plumbing system, without the heavy labor of hand pumping.

This booklet will help you plan your system so that it will serve you best. It is not intended to show you how to install your water system. The installation of piping and plumbing is a job requiring special knowledge and tools that few farm families have or will acquire. However, you and your family can learn from this booklet some simple, important facts about water systems and plumbing. You will see that the sketches and plans represent common farm buildings that can be adapted for use on your farm.

If your water system and plumbing is properly planned, installed, and maintained, it will give you water when and where you want it.

Planning is the job of the farmer and his family, who know most about their own living habits and needs. In making your plans you can seek the advice of your county agricultural agent, electric power use adviser, or other available qualified person.

Proper and adequate wiring protects people and animals, lessens fire hazard, and provides safeguards for electrical equipment.

Good planning results in a water system that gives adequate and satisfactory service with minimum maintenance. It also reduces the hazard of property damage from water leaks, water heater failures, and sewage pollution. *So plan well to get the most from your water system.*

In some areas the installation of plumbing and sewage disposal systems is regulated by local, county, or State codes. Therefore, consult your local health or sanitary authorities before proceeding with any construction. Code requirements take precedence over the recommendations in this booklet.

Consider the uses and needs for water and plumbing on your farmstead. You will want your system to supply all your present uses for water. In addition, you may want to take advantage of conveniences, such as a new bathroom, made possible by a pressure water system.

Think in terms of your future needs, even if you do not plan to put in the complete system at first. Planning now for future uses will make it possible for you to put in the first parts of your system so that they can later be added to, rather than torn out and replaced.

YOUR WATER REQUIREMENTS

Water consumption increases with the convenience afforded by an electric water system. The following table may be used to determine approximate water requirements for a farm:

Use:	*Amount (gallons per day)*
Each adult	50–100
Each child under 2 years	100
Each milk cow	35
Each horse, dry cow, or beef animal	12
100 chickens (mature)	7–10
100 turkeys (mature)	18
Each hog	4
Each sheep	2

Requirements may be even greater if extensive use is made of water to clean paved livestock areas. Many farmers are finding a 1-inch hose desirable for flushing paved areas. Such an operation may require more than 1,000 gallons of water an hour.

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Water Supply

Will your water supply be adequate? For instance, a well that does not supply enough water for a hand pump will be even less adequate when an electric water system is installed.

A safe water supply is very important. It is not good business to put a modern water system on an unsafe water supply, or on one likely to become contaminated. Consult your local health authorities or your county agricultural agent on quality of water and on proper protection for your well from both surface drainage and subsurface seepage sources of contamination.

Type of Pump

Your pump must be selected to fit your well. Pumps are of two types, shallow well or deep well. There are many different styles of pumps of these two types.

At sea level, a shallow-well pump can generally lift water only 25 feet. For each 1,000-foot elevation above sea level, the possible suction lift is reduced by about 1 foot. For example, if your farm is 5,000 feet above sea level, you can use a shallow-well pump only if the water in your well is not more than 20 feet lower than your pump.

Deep-well pumps are available in cylinder, jet, and submersible styles. A deep-well jet pump can be used in either shallow or moderately deep wells. Installation will vary according to depth of the well. For a shallow well, the jet assembly is located in the pump housing or adjacent to it and obtains water from the well by suction like any other shallow-well pump. For a deep well, the jet assembly is submerged in the water.

Some jet pumps will operate where the depth to water is several hundred feet. However, it is probable that, if the depth to water is more than about 90 feet, power costs will be less with a cylinder type or submersible pump than with a jet pump.

A submersible pump can be used when pumping from practically any depth. It has a specially designed, long, slim motor directly connected to the pump. Both the motor and its centrifugal style pump are located below the water level in the well and will fit into wells as small as 4 inches in diameter. The submersible pump will handle large quantities of water from a deep well with lower operating costs than will other styles of pumps. Other advantages of the submersible pump are: It has a relatively high efficiency over a wide range of discharge pressures and is capable of delivering large quantities of water against a high pressure; it has no priming problems; it is quiet; and the motor and pump require no weather protection. However, the purchase price of the pump may be higher than that of other styles, and the pump can be damaged by sand or abrasives.

Size of Pump

The first consideration in determining the size of your pump is the ability of the well to supply water to the pump. If the well is adequate for your needs, the most economical pump is one that will furnish water at the rate required during the time of day when water usage will be greatest. A 20-gallon per minute capacity would not be excessive where water will be used to flush paved areas or for firefighting on the farm. This is low when you consider that commercial firefighting equipment may require 500 or more gallons of water per minute.

If your well cannot supply water rapidly enough for your needs during periods of maximum consumption, some storage system is needed. Some farmers pump from a primary supply, such as a well, into a secondary supply, such as a cistern. The pressure system then operates from the secondary supply. Other farmers pump into a large tank that serves as a reserve and is elevated sufficiently to provide the necessary pressure.

Pressure Tanks

Pressure tanks provide a uniform pressure for your water system and prevent frequent stops and starts of the pump when water is being drawn slowly.

For your electric water system, therefore, you will probably want a pressure tank of either 42- or 80-gallon capacity. A 42-gallon tank will enable you to use about 8 gallons of water between the time the pump automatically stops and the time it automatically starts again. An 80-gallon tank will furnish about 16 gallons of water between each stop and start of the pump.

If you have a large livestock enterprise, it would be desirable for you to use a 120-gallon tank. A tank of this size will supply about 25 gallons of water between each stop and start of the pump. Some dairymen have found it advantageous to have an additional storage tank in the dairy barn rather than have one extremely large tank at the pump.

Locating Your Pump

If you are putting in a deep-well cylinder type pump, you will have to place it on the well platform directly over the well. In this case you should plan to build a shelter over the well to protect the pump and motor from rain and from freezing.

If you are putting in a shallow-well pump or a deep-well jet pump, you can place it in any convenient location within the suction limits of the pump so long as the pipe slopes continuously upward from the water in the well to the pump.

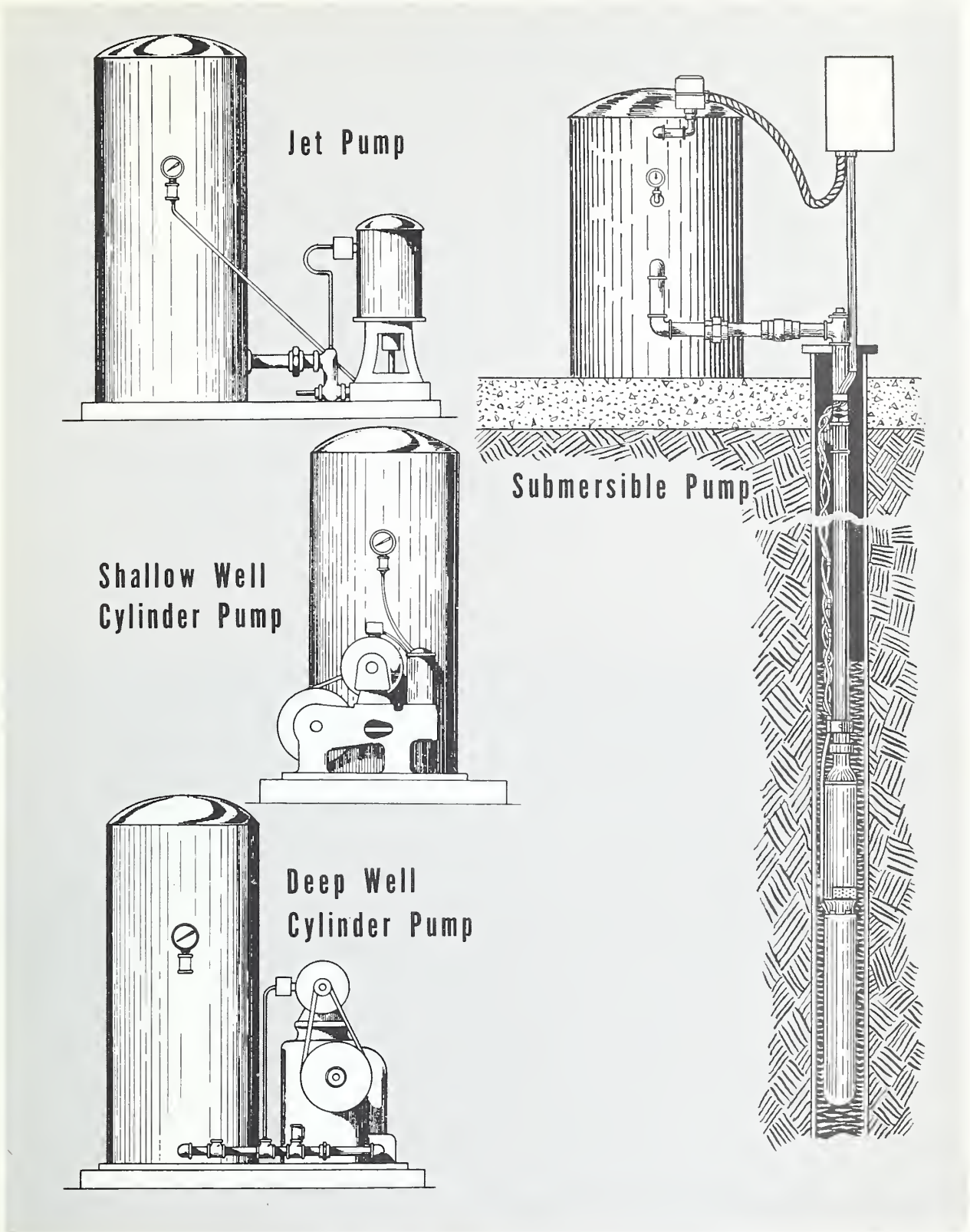

FIGURE 1.—Four styles of pumps available for electric water systems.

This means that you may be able to place your pump in the basement of your house or in some other protected location. In that way you can avoid building a separate shelter to protect it. A submersible pump, of course, does not require a pumphouse or other shelter, but pressure tanks used with these pumps should be protected.

The use of pump pits should be approached with caution. Some milk sanitation codes do not permit their use. If they are used, care should be exercised so that ground surface water cannot run into the pit. The pit should have a drain, and you should keep in mind that a damp pump pit is a dangerous place in which to use electrical equipment.

WATER-DISTRIBUTION PIPES

You may find it best to run a main pipe to your major use area with branches to other areas. The piping should be as short and as straight as possible; and, where it is exposed to freezing conditions, it should be laid so that it can be completely drained if necessary. Long pipes, elbows, or angles cause a drop in pressure and reduce the flow of water.

The pipes you put in should be large enough to deliver water at the full capacity of your water-supply equipment (pump and storage tank) at each main building, with not more than 5 pounds of pressure loss between the storage tank and the building.

Figure 2 shows you the size of pipe you will need to serve each building on your farmstead. Suppose your system has a capacity of 350 gallons per hour, and there are 200 feet of pipe from your water-storage tank to your barn. About halfway down the column headed "Capacity of pump in gallons per hour," you will find a figure "350." Read across the page from "350" until you find the column directly under the heading "200 feet." You will notice that you are now reading in a part of the chart labeled "1-inch pipe." This means that 1-inch piping would be the correct size to use.

Figure 3 shows a distribution system on a typical farm.

Both copper tubing and galvanized pipe are used for water-supply piping in the house. Either

Capacity of pump in gallons per hour	Length of Pipe												
	50 ft. or less	75 ft.	100 ft.	150 ft.	200 ft.	300 ft.	400 ft.	500 ft.	600 ft.	700 ft.	800 ft.	900 ft.	1000 ft.
100													
125													
150													
175			3/4" pipe										
200													
225													
250													
275													
300													
325													
350													
375							1 1/4" pipe						
400													
425													
450													
475													
500													
525													
550													
575													
600												2" pipe	
625													
650													

FIGURE 2.—Size selection chart for galvanized distribution pipe. The smoother bore of pipe such as copper or plastic will generally permit use of a smaller size pipe than that indicated in the chart. Check with your pipe dealer for specific recommendations.

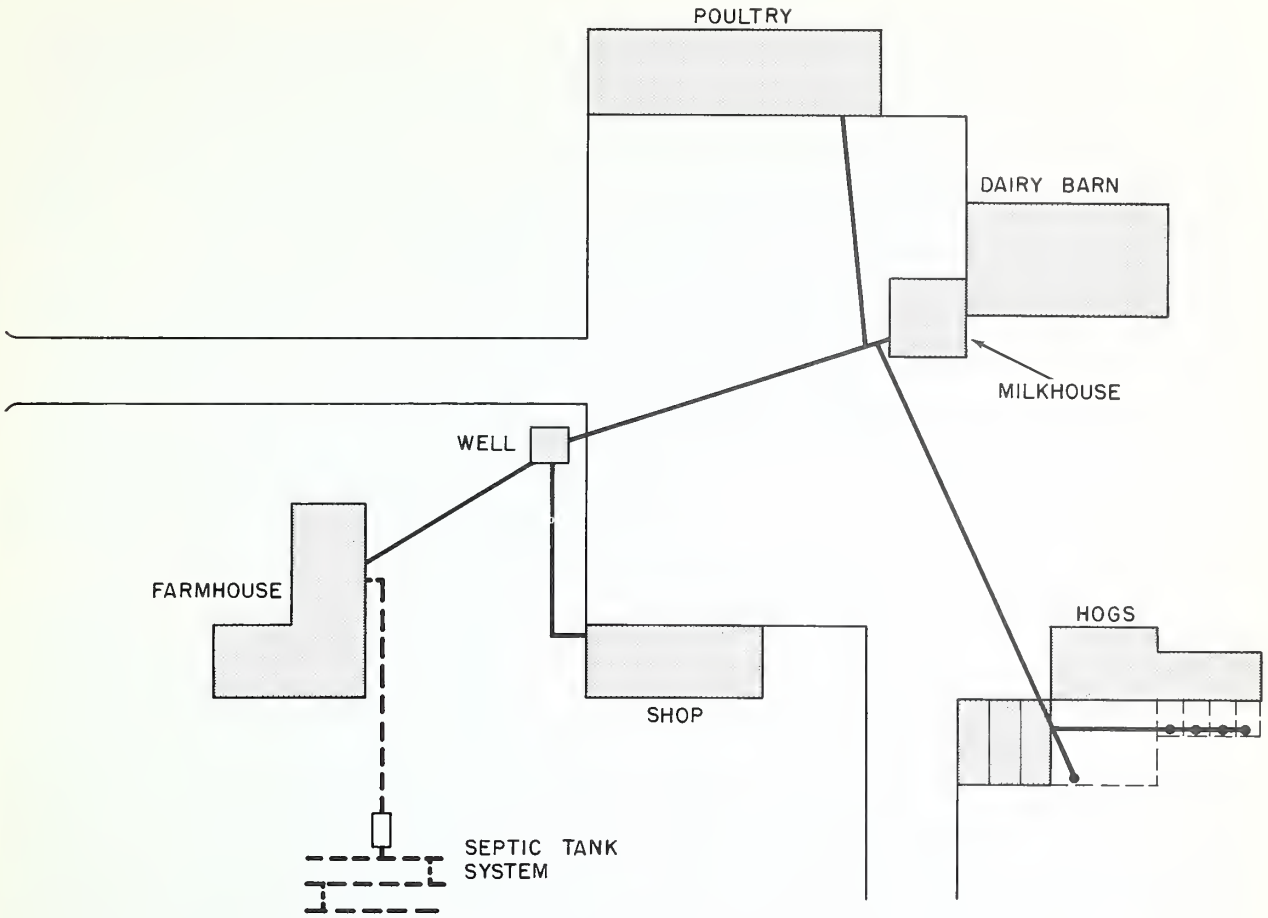

FIGURE 3.—Typical farmstead water-distribution system.

type makes a satisfactory installation. Plastic pipe is being used at present inside buildings for cold water only.

The distribution pipes carry water to all places where it is needed. One distribution system may lead through the water softener or other treating device and then to the water heater or any other place where treated water is desired. Another pipe may supply items not generally requiring water treatment. The following list shows some of the places in the farmhouse where hot and cold, treated and untreated, water are needed:

COLD WATER	*HOT WATER*
Kitchen	
Sink	Sink
Automatic dishwasher	Automatic dishwasher
Bathroom	
Lavatory	Lavatory
Bathtub	Bathtub
Shower bath	Shower bath
Water closet*	
Other Work Areas	
Lavatory or sink	Lavatory or sink
Laundry tubs	Laundry tubs
Automatic washer	Automatic washer
Workers' shower bath	Workers' shower bath
Clothes drier with condenser system	
Outdoors	
Outside faucet for washing cars, screens, storm sash, house, etc., and for lawn and garden watering.*	

*Water not treated.

Figure 5 shows the sizes of galvanized pipe or copper tubing that you will need.

KITCHEN EQUIPMENT

The style of sink you select will depend on the use to be made of it, the cost, and the space available for installation. Single- and double-bowl sinks with or without drainboards are available in porcelain-enameled cast iron and steel and in stainless steel. They may be obtained with flat rims for counter installation and with rolled rims

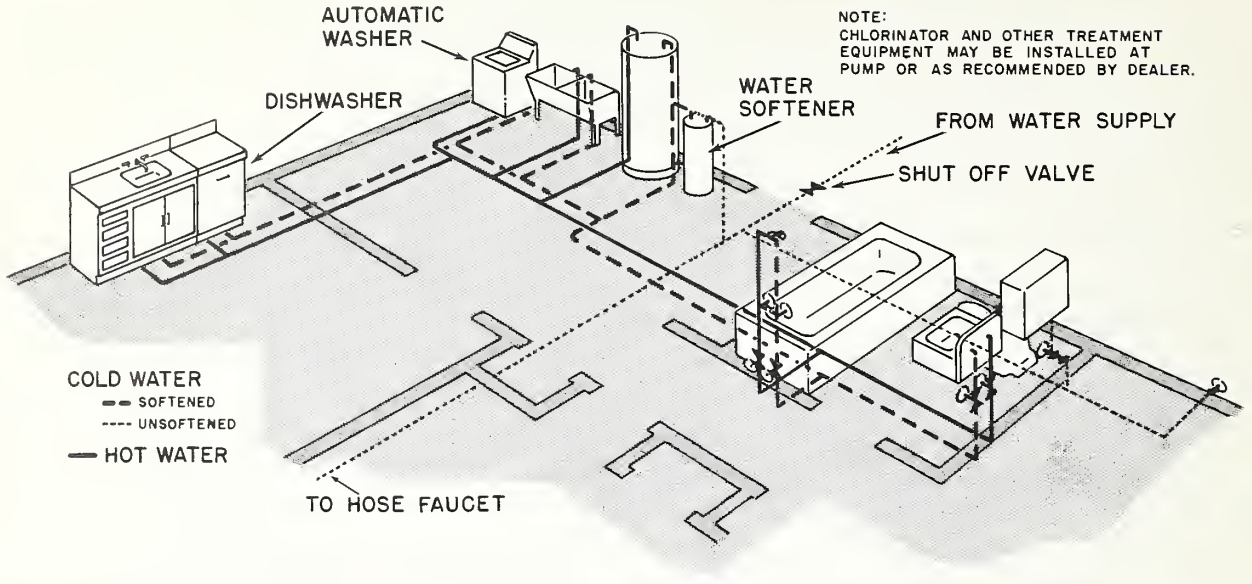

FIGURE 4.—Typical farmhouse water-supply piping layout. The outside hose faucets should be of a frostproof type.

for use with sink cabinets. Double-bowl sinks are convenient for preparing food for canning and freezing. For special kitchen arrangements, three-bowl sinks, double-bowl sinks with one shallow bowl, corner sinks, and sinks combined with a laundry tray are available. A cabinet sink may be advisable when only the sink area of the kitchen is being changed.

A dishwasher adds to the convenience of the modern kitchen. If built in, it can be placed to the right, to the left, or at right angles to the sink; but it should be placed to the side of the sink nearest the dish-storage area. Built-in dishwashers are of two general types as to opening—those that pull out from under the counter and fill from the top, and those that open at the front and have pull-out shelves.

You may want to plan your water system and sewage disposal system to accommodate a food waste disposer in your sink.

BATHROOM EQUIPMENT

You should plan your bathroom carefully to meet the needs of your family. Its size will depend on the style, size of equipment, and arrangement.

Bathroom fixtures are made of porcelain-enameled cast iron and steel, vitreous china, stainless steel, and fiberglass-reinforced plastic. The water closet is always made of vitreous china; the most commonly used bathtubs are of enameled cast iron or steel, but some are available in other materials. Lavatories are available in all these materials and may be counter installed or wall hung.

It is often desirable to have at least a partial bath (water closet and lavatory) near the service entrance or back door of a farm home.

For further details on bathroom planning, see Home and Garden Bulletin No. 19, Your Farm

Number of faucets served by pipe	Length of Galvanized Pipe													
	10 ft.	15 ft.	20 ft.	25 ft.	30 ft.	35 ft.	40 ft.	45 ft.	50 ft.	60 ft.	70 ft.	80 ft.	90 ft.	100 ft.
1	1/2" pipe													
2						3/4" pipe								
3 or more														

No. of faucets served by tubing	Length of Copper Tubing													
	10 ft.	15 ft.	20 ft.	25 ft.	30 ft.	35 ft.	40 ft.	45 ft.	50 ft.	60 ft.	70 ft.	80 ft.	90 ft.	100 ft.
1	3/8" tubing							1/2" tubing						
2	1/2" tubing													
3 or more													1" tubing	

FIGURE 5.—Size selection charts for galvanized pipe and for copper tubing needed to serve various numbers of faucets.

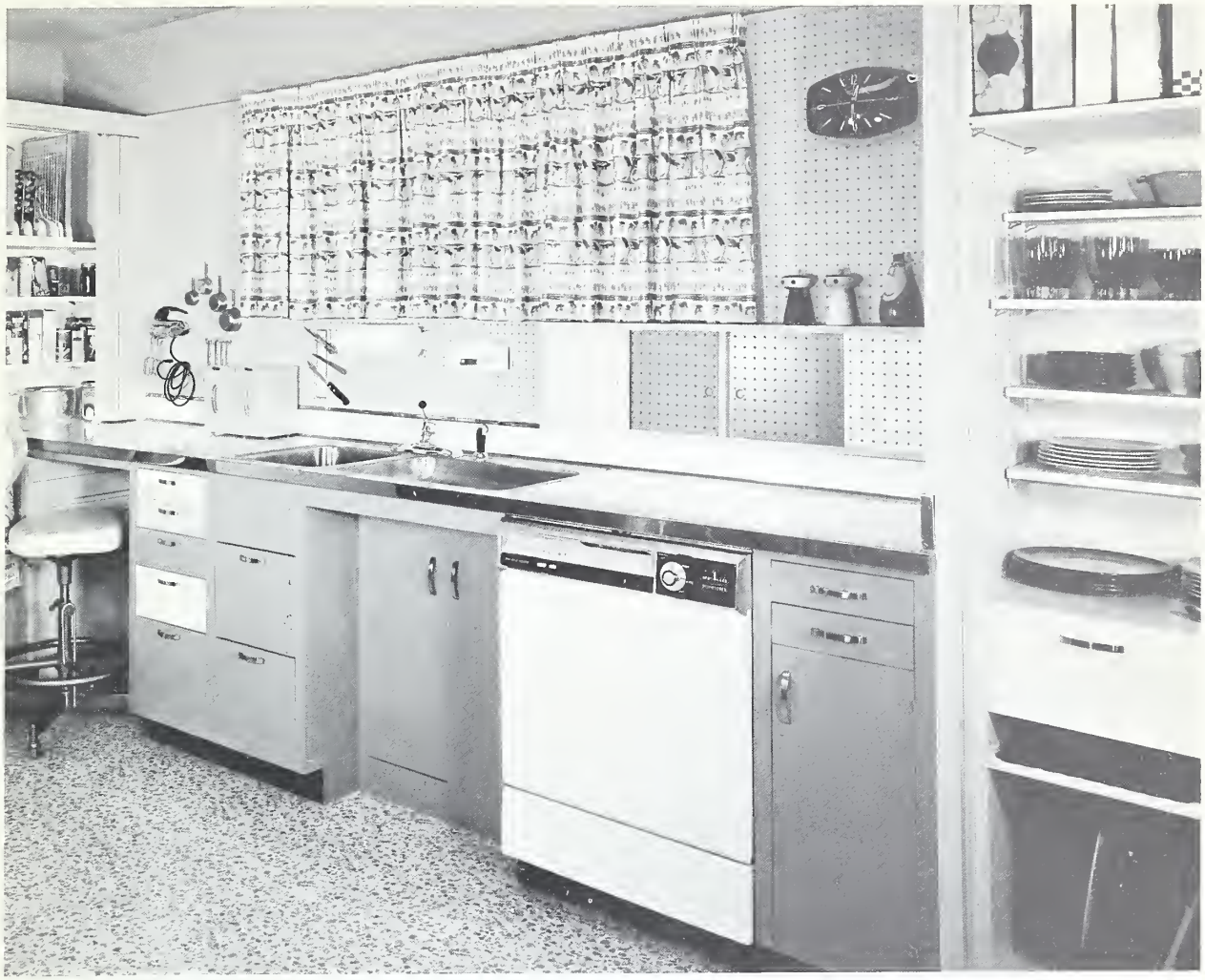

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FIGURE 6.—View of a Beltsville Energy-Saving Kitchen, showing double sink and dishwasher. The dishwasher is located convenient to dish-storage area.

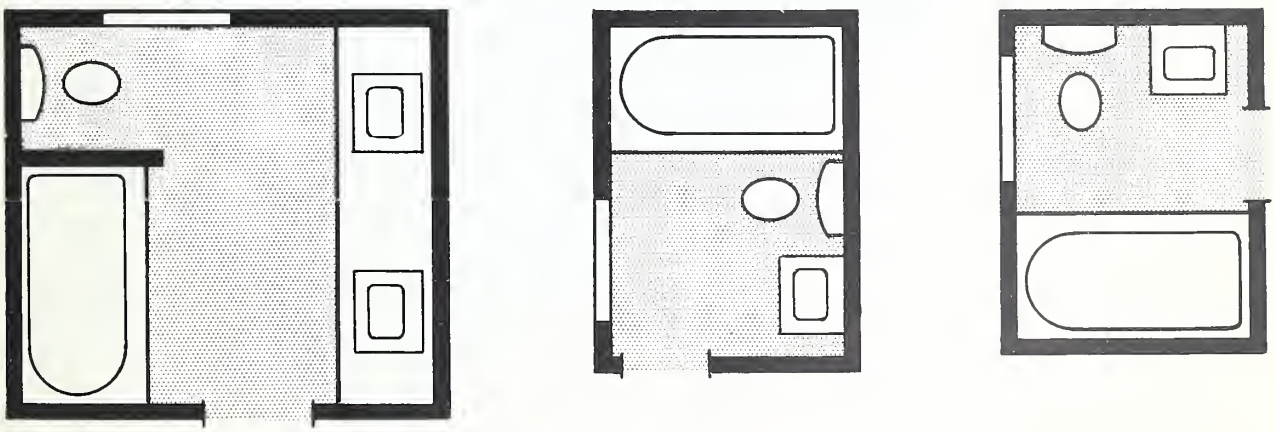

FIGURE 7.—Three typical bathroom arrangements. Linen storage should be provided either in or convenient to the bathroom.

House—Planning the Bathroom (available from the Office of Information, U.S. Department of Agriculture, Washington 25, D.C.).

OTHER HOME EQUIPMENT

Provisions are needed for laundry facilities. A food preservation center is sometimes included in the laundry area. Hot and cold water and separate drains are needed for each facility.

Stationary laundry tubs may be desirable in farmhouses even when an automatic washer is used. Single- or double-compartment laundry tubs are available in enameled cast iron, concrete, or fiberglass-reinforced plastic. Clothes driers with water condensers must be connected to the cold-water piping. The amount of laundry to be done and the location of the laundry area should be considered when choosing your equipment.

If tubs are not needed for laundry, a kitchen sink may be a better choice for this area. A sink would be convenient for washing vegetables and produce as well as for hand laundry.

EQUIPMENT FOR SERVICE BUILDINGS

You will want water in several of your service buildings as well as in your house. In some buildings, such as your hoghouse or your chicken-house, your shop, or your machine shed, one faucet or hydrant may be enough. In places such as dairy buildings, you may need several faucets. It is good practice to continue pipe the same size as your water-service pipe to one faucet, with a hose connection in each building. This will make it possible for you to use a hose to its full capacity for firefighting, cleaning, and similar uses. You should give special consideration to distribution pipe size if you anticipate using 1-inch hoses for cleaning.

In all buildings where there is danger of the pipes freezing, you should provide for draining the distribution pipes by some means such as a stop-and-waste valve between the service pipe and the distribution pipes. The stop-and-waste valve may be buried in the ground where your pipe enters the building. This valve will allow all the water in the distribution pipes to drain into the

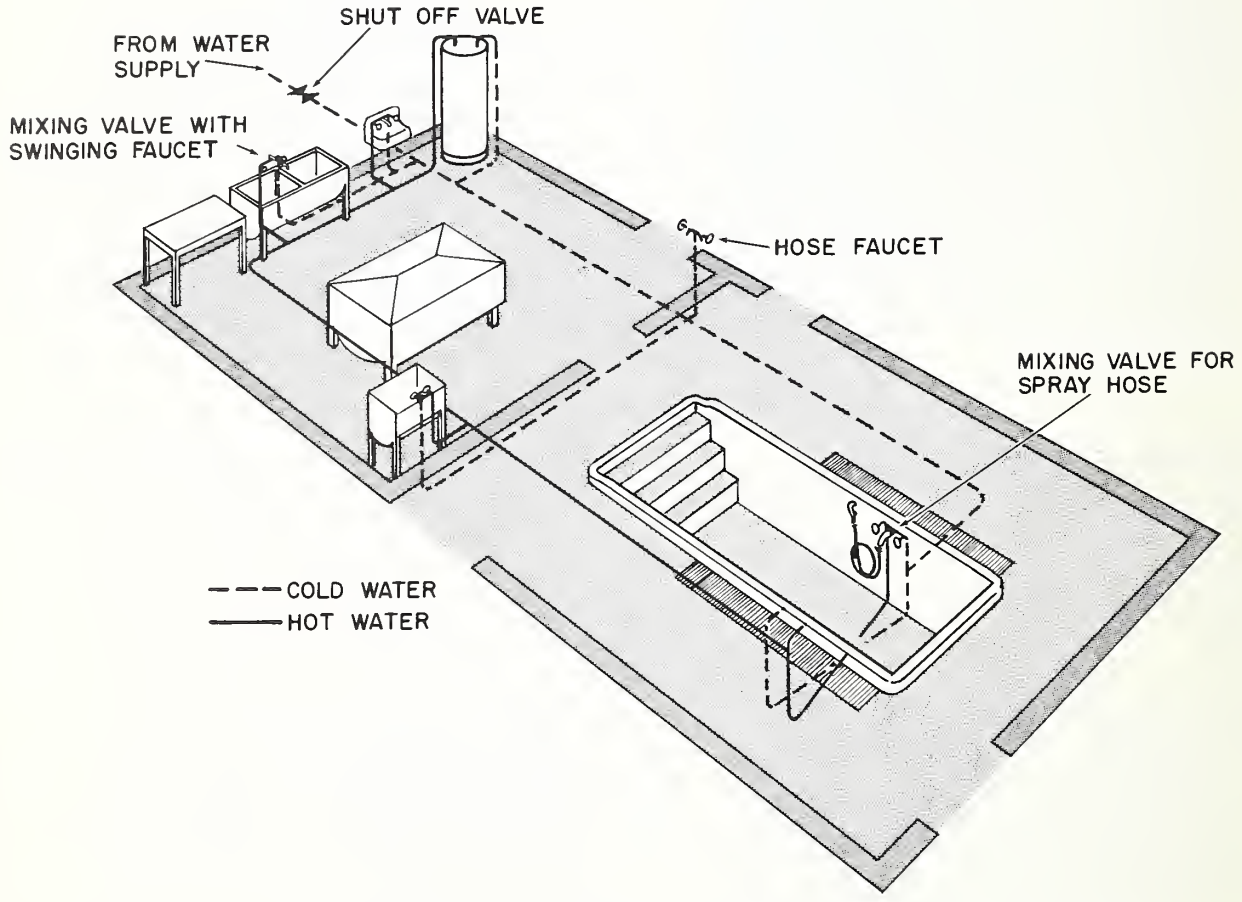

FIGURE 8.—Typical water-supply piping layout for an elevated-stall milking room and adjoining milkroom.

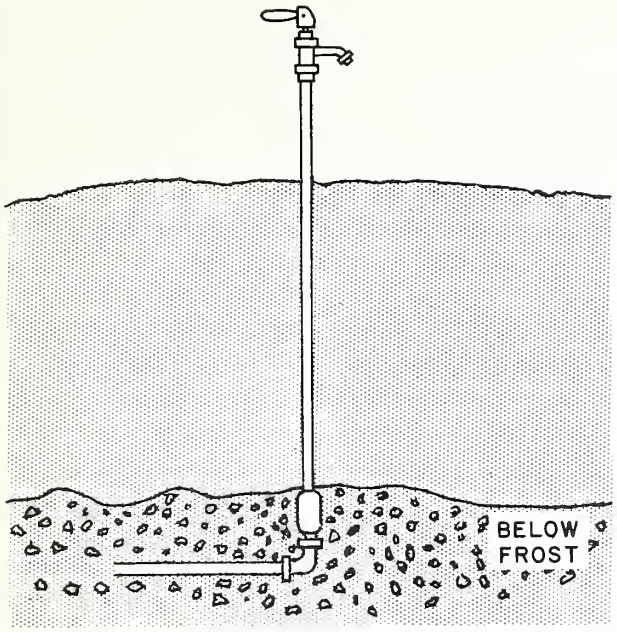

FIGURE 9.—Frostproof hydrant with stop-and-waste valve. To be frostproof, the valve and gravel must be below frost.

ground when the valve is closed by a handle extending above the ground.

Sometimes it is desirable to have a shower in one of the service buildings for use of farm laborers. Prefabricated metal shower compartments are available, or you may construct one in place.

It would be wise to prepare a plan for each building, showing where you want faucets, drinking cups, or other types of watering devices. Remember also to allow for a water-distribution system to pastures or feedlots.

ELECTRIC WATER HEATERS

Farmstead electric water heaters should be of 52-gallon capacity or more. If smaller, they should be of the "fast-recovery" type (4,500 watts upper and 4,500 watts lower heating element, interlocked so that only one is on at a time). If your water is corrosive, you will want to consider treatment or installing a glass-lined tank. Hot water will also be needed in your milkhouse.

Be sure to check with your power supplier for electrical service limitations and wiring recommendations before buying your water heater. For water heating, special electric rates are sometimes available, and there may be some installation savings on certain types of heaters.

There are probably several places in your house where your water heater can be placed. Select the one that will require the shortest pipes from the heater to the faucets where hot water will be used most frequently. Long runs of hot-water pipe result in heat loss and lower water temperature at the faucet. They also result in wasted water because of the amount that has to be run before hot water reaches the faucet. Where hot water is provided at widely separated points, more than one water heater may be desirable.

An electric storage heater consists of an inner tank that contains the heating elements and the water, and a round or square outer casing. The space between is filled with insulation. Each heating element is controlled by a thermostat. Some heaters have one heating element and one thermostat; others have two heating elements and two thermostats. The latter are more satisfactory on farms and in some cases are required by the power supplier.

The cost of operating your electric water heater will depend on your electric rate and the amount of hot water you use.

WATER TREATMENT

The most common form of water treatment is softening, as hard water is a problem in many parts of the United States. The dissolved calcium and magnesium compounds in hard water form a scale in water pipes, water heaters, and utensils; form rings in the bathtub; spot crystal; and in general make cleaning chores more difficult. These compounds also retard tenderizing of food during cooking.

Soft water, on the other hand, is free of these difficulties, saves on soap, and is less harsh on fabrics than is hard water.

Rain water may be caught and stored in cisterns to provide needed soft water. However, hard water may be softened by use of water-softening equipment. Commercial water softeners are available in a variety of sizes and with varying degrees of automation.

The most common water softeners are cylindrical steel tanks, similar to domestic water heaters, that contain zeolite or resin beads. When hard water passes through, calcium and magnesium ions are exchanged for ions of sodium. Sodium compounds do not cause hardness, and softer water results.

The size of water softener required depends on both the hardness of the water and the rate at which softened water is used. To determine the softener best suited to your conditions, obtain the services of a reliable dealer. He can test the water and determine its hardness. From the rate of soft water consumption and the acceptable period between regenerations, the required capacity of the water softener can be determined. Check with the dealer to be sure that your water system has adequate pressure to accommodate the unit.

Regeneration is necessary when the zeolite or resin has exhausted its softening properties. The

softener is regenerated by backwashing or reversing the flow of water in the softener, adding salt, and slowly rinsing. Water-softening equipment is available for manual, semiautomatic, or automatic regeneration. Some softeners are regenerated by direct addition of salt; others use a brine tank.

Principal operating costs are the cost of the salt, plus the water for the backwashing and rinsing. Some commercial companies rent this equipment.

Water for the water closet and for the lawn, garden, and most other nonhousehold uses should not be softened. Water for these purposes can bypass the softener.

To gain maximum advantage from water softening, both hot and cold water should be softened.

Some waters have other undesirable properties such as iron, corrosiveness, turbidity, odors, or unpalatable taste. Your water treatment equipment dealer can advise you on the availability of equipment for treating these conditions.

WASTE-DISPOSAL PIPING

The waste-disposal piping in your house is among the most important parts of your plumbing installation. To insure good sanitation and freedom from trouble, this piping should be of proper materials and should be properly installed. What you need in piping depends on the fixtures you put in and the arrangement of your house.

Every fixture must waste through a trap so that sewer odors will not come back through your house. The septic tank system should be adequate to handle all the drainage from the kitchen, bath, and laundry.

The waste-disposal piping must be large enough to handle all the wastes. It must be vented to the outside air at the roof to allow sewer gases to escape and to maintain atmospheric pressure throughout the piping. All fixtures must be vented to prevent siphoning of the water from the fixture traps.

Your house drain becomes your house sewer about 5 feet outside the house. The sewer will connect your house drain with your septic tank. It may be of cast-iron soil pipe, clay or concrete sewer tile, asbestos cement, bitumenized fiber, or plastic. Any part of a sewer that passes under a driveway or any other place where it would be subject to mechanical damage should be of extra-heavy cast-iron soil pipe. The sewer must be watertight to the septic tank.

SEPTIC TANK

In the absence of a community sewerage system, a septic tank with a drain-tile disposal field is the most desirable means of disposing of household wastes, except in unusual situations. Be sure to consult your local health officials before planning to use any other means, such as a cesspool. Septic tanks with their disposal fields will probably re-

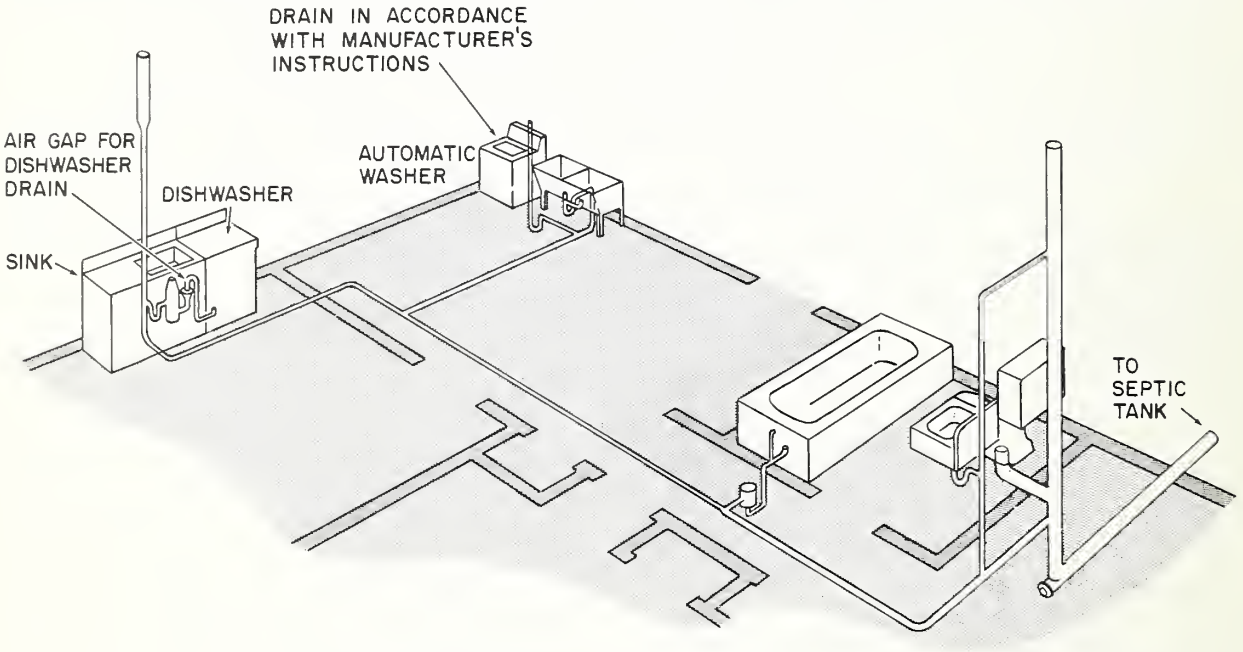

FIGURE 10.—Typical farmhouse waste-disposal piping. Under no circumstances should the water-supply piping connect to the waste-disposal piping. The vent extension through the roof may need to be enlarged where there is danger of frost closure.

quire the least amount of maintenance and are less likely to contaminate the water supply.

A septic tank is a closed but vented, watertight chamber in which the sewage remains long enough for most of the solid matter to decompose or settle out. The gases escape through vents, through the soil of the disposal field, or through the house drain and main vent in the house. The bacteria that bring about this decomposition are anaerobic; that is, they live where there is no air.

No "starter" or other material need be put in the septic tank to start its functioning. All the organisms that are needed will be in the sewage.

The tank is essentially a settling basin, and the liquid that flows from it is still sewage. Some purification takes place in the soil after the sewage has seeped from the disposal tile and has been acted on by aerobic soil organisms.

The septic tank should be so constructed that neither the incoming nor the outgoing sewage agitates the contents appreciably. This is sometimes done by placing baffles in the tank so that the flow will not stir up the main contents. It is accomplished also by having the incoming sewage deposited straight downward several inches below the surface of the contents and having the effluent taken straight upward from about 18 inches below the surface at the other end of the tank.

Your septic tank may be made of concrete, tile, steel, or brick. Steel tanks need the protection of an unbroken coating of a material such as asphalt to prevent early corrosion of the metal. Some authorities estimate that the life of No. 12 gage steel tanks averages about 10 to 15 years. A well-built concrete or tile tank can last indefinitely.

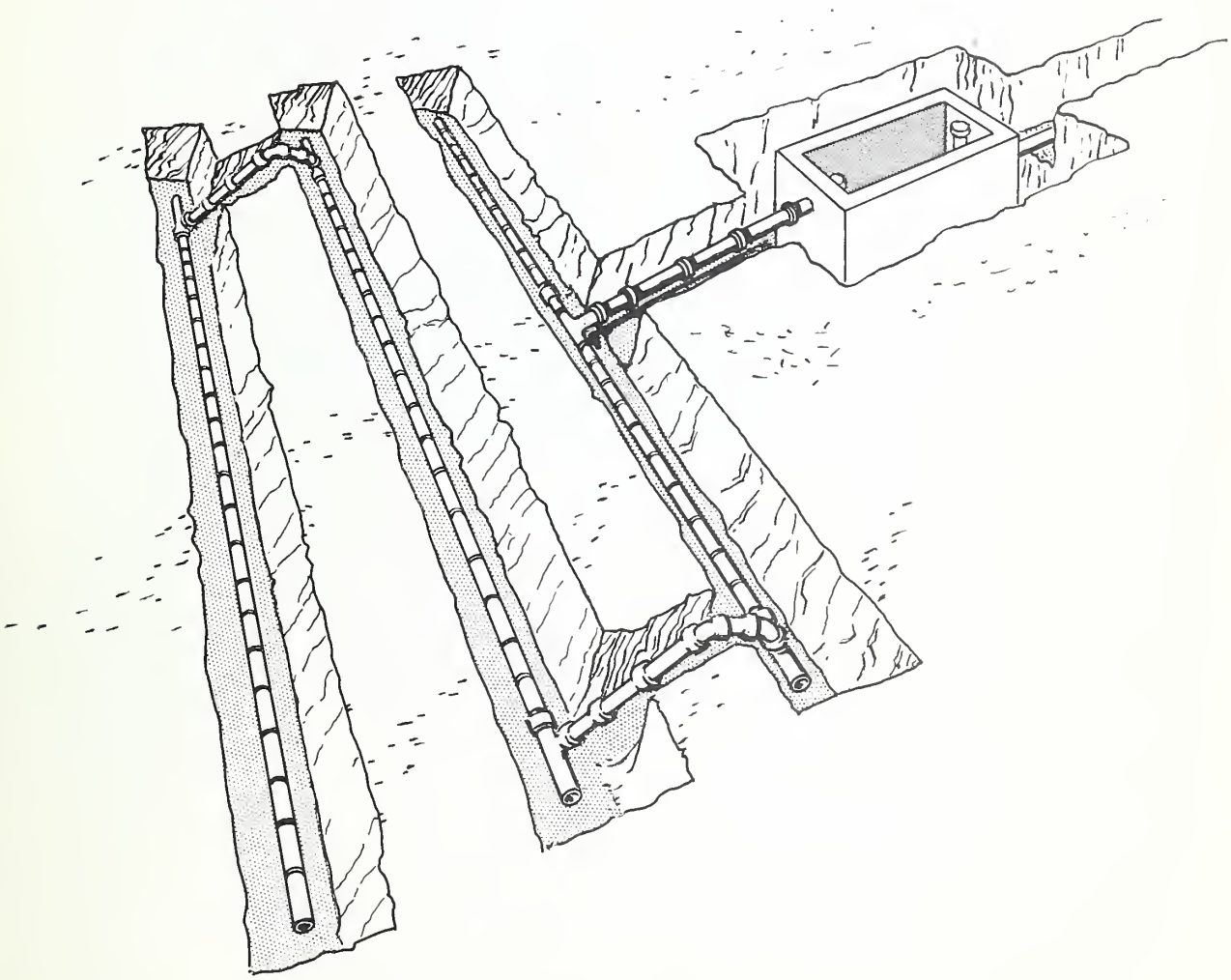

FIGURE 11.—Typical serial distribution arrangement for septic tank disposal field. This arrangement is adapted to sloping locations. The closed or continuous loop arrangement is recommended for flat locations.

The septic tank should be large enough to provide for the greatest number of persons that may occupy the house. It should also accommodate a food waste disposer unit. The minimum capacity recommended for a house with a waste disposer unit is 750 gallons.

Except for the disposal field, the entire sewerage system must be of watertight construction. The distance that should separate all sewage seepage and your well will depend on local conditions but in most cases should be at least 100 feet. It is advisable to check this with your local health authorities.

Your septic tank disposal field should be made of 4-inch drain pipe buried about 18 to 24 inches in the soil. There is little danger of the lines freezing, even in cold areas, so long as warm water is discharged into them daily, as would be done in any normal household.

In flat locations, where the slope of the ground surface does not exceed 6 inches in any direction within the area used for the disposal field, the disposal lines may be arranged in a closed or continuous system with open-jointed or perforated pipe used throughout. The lines are laid on a flat grade, and the entire trench length is counted in the effective area. For practically all locations where the slope of the ground surface exceeds 6 inches in any direction within the confines of the disposal field, serial distribution of effluent is recommended. Excessively steep slopes that are subject to erosion should be avoided.

In serial distribution, the individual trenches are arranged so that each trench is forced to pond to the full depth of the gravel fill before the effluent flows into the succeeding trench. Advantages of this system are that it minimizes the importance of variable absorption rates in different parts of the field by forcing each trench to absorb effluent until its ultimate capacity is utilized; it causes each trench in the system to be used to full capacity before failure occurs; and it eliminates the need for a distribution box.

The drain lines in your disposal field should be spaced at least 6 feet apart. If you have plenty of room, a spacing about 10 feet apart is better. You should place a bed of gravel at least 6 inches deep, and the full width of the trench, under the disposal pipe. The gravel should also extend to the top of the pipe.

The number of square feet of trench bottom needed to absorb the effluent from a given septic tank system is determined by making a percolation test and taking into account the size of installation. The smallest installation, in the most porous soil, should use at least 150 square feet. Trench bottom width will probably be 18 to 24 inches. The wider the trench bottom is, the shorter it may be; consequently, less pipe will be needed. However, trench width should not be greater than 36 inches, and individual runs should not be longer than 100 feet.

Consult your power use adviser, your county agricultural agent, or your local health officials on the amount of tile and gravel you will need according to the soil type on your farm. Additional information may also be obtained from Public Health Service Publication No. 526, Manual of Septic-Tank Practice, by the U.S. Department of Health, Education, and Welfare (available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., for 40 cents).

Growth Through Agricultural Progress